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LIQUID CRYSTAL DRIVING DEVICE

PUB. NO.: **62-194231** [JP 62194231 A]
PUBLISHED: August 26, 1987 (19870826)
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APPL. NO.: 61-035738 [JP 8635738]
FILED: February 20, 1986 (19860220)
INTL CLASS: [4] G02F-001/133; G02F-001/133; G09F-009/35
JAPIO CLASS: 29.2 (PRECISION INSTRUMENTS -- Optical Equipment); 44.9
(COMMUNICATION -- Other)
JAPIO KEYWORD:R005 (PIEZOELECTRIC FERROELECTRIC SUBSTANCES); R011
(LIQUID
CRYSTALS)
JOURNAL: Section: P, Section No. 665, Vol. 12, No. 46, Pg. 141,
February 12, 1988 (19880212)

ABSTRACT

PURPOSE: To obtain the high speed responsible effect of a liquid crystal molecule by forming a transparent electrode having two layer structures on a pair of glass substrates respectively to form an electric field in a horizontal direction, and by using the liquid crystal molecule having a permanent dipole moment which is perpendicular to a long molecular direction.

CONSTITUTION: The 1st transparent electrode 2 and the 1st insulating film 3 are formed on the glass substrate 1 respectively. The 1st transparent electrode 2 and the 1st insulating film 3 are formed on the glass substrate (B) 11 respectively in the same manner as in the glass substrate (A) 1. The 2nd transparent electrode 4 having 100.mu.m of the electrode width is formed on the glass substrate (B) 11 so as to put in parallel two dependent

electrodes at 200.mu.m away with each other. The liquid crystal 6 is composed of a ferroelectricitic liquid crystal having the permanent dipole moment 7 perpendicular to a longitudinal direction of the molecular axis of the liquid crystal. At first, the permanent dipole moment of the liquid crystal is received the torque having the direction of 90 deg. angle due to the electric field in the horizontal direction which generates by impressing an electric voltage between the 2nd transparent electrodes. Secondly the direction of the molecular orientation also changes responsing again to the electric field in the direction of from the glass substrate (B) 11 to the glass substrate (A) 1. Thus, the torque of the liquid crystal molecule is enlarge, thereby enabling to be responsed the liquid crystal with more high speed.

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⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　昭62－194231

⑤Int.Cl.⁴	識別記号	庁内整理番号	④公開　昭和62年(1987)8月26日
G 02 F 1/133	323 336	8205－2H 7348－2H	
G 09 F 9/35		6731－5C	審査請求　未請求　発明の数 1　(全3頁)

⑤発明の名称　液晶駆動装置

⑳特　願　昭61－35738
㉒出　願　昭61(1986)2月20日

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明　細　書

1　発明の名称

液晶駆動装置

2　特許請求の範囲

(1)　一対のガラス基盤の一方に第一透明電極を有し、前記第一透明電極上に第一絶縁膜を有し、前記第1絶縁膜上に第二透明電極を有し、前記第二透明電極上に第二絶縁膜を有し、他方のガラス基盤上には前記第一透明電極及び第一絶縁膜を有し、液晶分子の長分子軸に対して垂直方向に永久双極子モーメントを有する液晶分子を前記一対のガラス基盤にはさみ込んだことを特徴とする液晶駆動装置。

3　発明の詳細な説明

〔産業上の利用分野〕

〔発明の概要〕

本発明は表示素子などに用いる液晶駆動装置において、ガラス基盤に対して横方向電界を作り、一方のガラス基盤上の透明電極を二層構造にし、長分子方向に対して垂直に永久双極子モーメントを有する液晶分子を用いることにより、液晶分子の高速応答効果を得るものである。

〔従来の技術〕

従来、液晶表示装置の構造に関しては数多くの提案がなされ、改良が加えられている。

例えば、Mol. Cryst. Liq. Cryst., 1983, Vol. 94 PP. 213 ~ 234 には第2図にあるように、ガラス基盤12上に透明電極8が蒸着され、その上に絶縁膜9を有する二枚のガラス基盤に対して平行になるようにはさみ、ガラス基盤上に形成された一対の透明電極8に電圧を印加する事により、ガラス基盤に対して垂直方向に電界を発生させ、液晶分子の配向方向を変化させる液晶駆動装置が提案

〔発明が解決しようとする問題点〕

しかし、前述の従来の技術は電界を印加する為のガラス基盤上に蒸着された透明電極は一層構造の為、ガラス基盤に対して垂直な電界、すなわち分子軸方向に対して垂直方向に永久双極子モーメントを有する液晶分子に対しては永久双極子モーメントに対して180度方向に電界をへ、液晶分子の応答性を向上させる為には印加電界を増すか、永久双極子モーメントの大きな液晶材料を開発する必要がある。

本発明は、このような液晶駆動装置の問題点を解決するもので、その目的とするところはより液晶分子の高速応答が可能であり、より高性能な液晶駆動装置を提供するところにある。

〔問題を解決するための手段〕

上記問題点を解決するために、本発明の液晶駆動装置は、一対のガラス基盤の一方に第一透明電極を有し、前記透明電極上に第一絶縁層を有し、前記絶縁層上に第二透明電極を有し、前記第二絶縁層を有し、他方のガラス基盤上には、前記第一透明電極及び第一絶縁層を有し、液晶分子の長分子軸に対して垂直方向に永久双極子モーメントを有する液晶分子を前記ガラス基盤間にはさみ込んだことを特徴とする。

〔実施例〕

第1図は本発明の実施例における液晶駆動装置の断面図である。

まず、ガラス基盤(A)1上に第一透明2として、例えば酸化インジウム膜(ITO膜)を300Å程度蒸着する。さらに、その上に第一絶縁層5として例えば、ポリビニールアルコール(PVA)を500Å程度形成させる。次に、ガラス基盤(B)11上にもガラス基盤(A)1と同様な方法で第一絶縁層5まで形成する。さらに、この上に第2透明電極4として例えば、酸化インジウム膜を300Å程度蒸着する。この第2透明電極4は電極幅が100μmで2本の独立した電極が200μm離れて平行に位置するように形成する。これは各種のエッチング技術で達成される。次にその上に第二絶縁膜5を、500Å程度形成させる。そしてこれらの2枚のガラス基盤とスペーサ10を用いて液晶6をはさみ込む。この液晶6は液晶分子の長分子軸方向に垂直方向に永久双極子モーメント7を有する液晶、すなわち、強誘電性液晶を用いる。現在開発されている強誘電性液晶はスメクティック液晶の中でカイラル・スメクティックC相を示す。液晶分子はガラス基盤に対して平行に配向させる為には、例えば、*P-decyloxybenzylidene P'-amino 2 methyl butyl cinnamate* を使用する場合には、ガラス基盤間の間隔は1μm程度に保つ事により得られる。また液晶分子は第二透明電極の長さ方向(紙面に垂直)に平行に配向させる。これは、ガラス基盤に対してラビング処理等を施す事により可能である。

このような液晶セルに対して、まず、第二透明電極4間に電圧を印加し、ガラス基盤に対して横方向の電界を作る。続いてガラス基盤(B)11の第一透明電極2からガラス基盤(A)1の第一透明電極[illegible]

して いる時は横電界は印加しない)。

以上のような実施例において、液晶分子の永久双極子は、まず第二透明電極間の電圧印加による横電界により90度方向のトルクを生じ、その電界方向に永久双極子の向きを変える。すなわち、分子配向方向も変化する。そして、次に行なうガラス基盤(B)11からガラス基盤(A)1方向への電界により再び液晶分子の永久双極子が応答し、分子の配向方向も変化する。

このようにして液晶分子を応答させる事により従来のガラス基盤12間に電界を加える方式より液晶分子のトルクが大きくなる事より、液晶分子をより高速に応答させる事ができる。

また、低電圧で広範囲に横電界を得る為には、第3図に示すように、第二透明電極4を櫛歯型に各第二透明電極間を抵抗体で接続し、両端の第二透明電極間に電圧を加えることで、広範囲に横電界を得ることができるので表示素子等にも応用で

〔発明の効果〕

本発明は以上説明したように第二透明電極を有した構造にする事により、液晶分子に大きな回転トルクを与える事ができるために、従来の方式よりもより高速で液晶分子を応答させる効果がある。

4. 図面の簡単な説明

第1図、第3図は本発明の一実施例を示す液晶駆動装置の断面図。

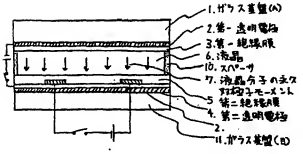
第2図は従来の液晶駆動装置の断面図。

1 …… ガラス基盤(A)
2 …… 第一透明電極
3 …… 第一絶縁膜
5 …… 第二絶縁膜
6 …… 液晶
7 …… 液晶分子の永久双極子モーメント
8 …… 透明電極
9 …… 絶縁膜
10 …… スペーサ
11 …… ガラス基盤(B)
12 …… ガラス基盤

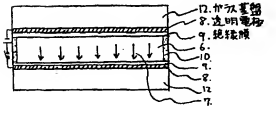
以 上

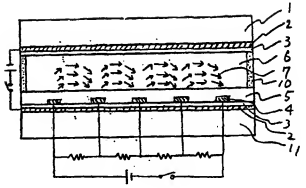
出願人 セイコーエプソン株式会社

代理人 弁理士 最上 [illegible] 名



第1図





第3図

(19) Japanese Patent Office (JP)

(12) Publication of Patent Application (A)

(11) Patent Application Publication No. 62-194231

(43) Publication Date: August 26, 1987

(51) Int. Cl.[4]		Identification Symbol	Office Reference Number
G02F	1/133	323	8205-2H
		336	7348-2H
G09F	9/35		6731-5C

Request for Examination: Not Requested

Number of the Invention: 1 (3 pages in total)

(54) Title of the Invention: Liquid crystal driving device

(21) Patent Application No. 61-35738

(22) Patent Application Date: February 20, 1986

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Description

1. Title of the Invention

Liquid Crystal Driving Device

2. Scope of Claim

(1) A liquid crystal driving device characterized by comprising:

a first transparent electrode formed over one of a pair of glass substrates;

a first insulating film formed over the first transparent electrode;

a second transparent electrode formed over the first insulating film;

a second insulating film formed over the second transparent electrode;

the first transparent electrode and the first insulating film formed over the other glass substrate,

wherein a liquid crystal molecule whose permanent dipole moment is vertical to a major molecular axis of the liquid crystal molecule is interposed between the pair of glass substrates.

3. Detailed Description of the Invention

[Industrial Field of the Invention]

The present invention relates to a liquid crystal driving device used for a display element or the like.

[Summary of the Invention]

The present invention is a liquid crystal driving device used for a display element or the like, in which a transverse electric field is generated with respect to glass substrates; a transparent electrode over one glass substrate is formed to have a two-layer structure; a liquid crystal molecule whose permanent dipole moment is vertical to the major molecular direction is used. Therefore, effect of high speed response of the liquid crystal molecule can be achieved.

[Prior Art]

Conventionally, many suggestions relating to a structure of a liquid crystal display device have been proposed to improve the structure.

For example, a liquid crystal driving device as shown in FIG. 2 is suggested in Mol. Cryst. Liq. Cryst., 1983, vol. 94 PP. 213-234, in which transparent electrodes 8 are evaporated over glass substrates 12, liquid crystal is interposed parallel to the two glass substrates having insulating films 9 over the transparent electrodes 8, and an electric field is generated vertical to the glass substrates by applying voltage to the pair of transparent electrodes 8 formed over the glass substrates to change an orientation direction of a liquid crystal molecule.

[Problem to be Solved by the Invention]

However, in the above described conventional technique, the transparent electrodes evaporated over the glass substrates for applying an electric field are each formed in a single layer structure, an electric field perpendicular to the glass substrate, that is, an electric field is applied in 180° direction with respect to the permanent dipole moment for liquid crystal molecule which has a permanent dipole moment perpendicular to molecular axis, and it is necessary to increase an applied electric field or to develop a liquid crystal material with increased permanent dipole moment in order to improve responsibility of a liquid crystal molecule.

The present invention is to solve the above problem of the liquid crystal driving device, and it is an object of the present invention to provide a liquid crystal driving device with higher speed response of a liquid crystal molecule and higher performance.

[Means for Solving the Problem]

In order to solve the above problem, a liquid crystal driving device of the present invention is characterized by comprising: a first transparent electrode formed over one of a pair of glass substrates; a first insulating film formed over the transparent electrode; a second transparent electrode formed over the insulating film; a second insulating film; the first transparent electrode and the first insulating film formed over the other glass substrate, wherein a liquid crystal molecule whose permanent dipole moment is vertical to a major molecular axis of the liquid crystal molecule is interposed between the glass substrates.

[Embodiment]

FIG. 1 shows a cross-sectional view of a liquid crystal driving device according to an embodiment of the present invention.

First, as a first transparent 2, for example, an indium oxide film (an ITO film) is evaporated over a glass substrate (A)1 in approximately 300 Å thick. Further, as a first insulating film 3, for example, polyvinyl alcohol (PVA) is formed thereover in approximately 500 Å thick. Next, the same method as used in the glass substrate (A)1 is used to form up to the first insulating film 3 over a glass substrate (B)11, too. Furthermore, as a second transparent electrode 4, for example, an indium oxide film is evaporated thereover in approximately 300 Å thick. In the second transparent electrode 4, two independent electrodes each width of which is 100 μm are formed 200 μm away from each other and parallel to each other. The above electrodes can be obtained by using various etching techniques. Next, a second insulating film 5 is formed thereover in approximately 500 Å thick. Then, liquid crystal 6 is interposed by using these two glass substrates and a spacer 10. Liquid crystal whose permanent dipole moment 7 is vertical to the direction of a major molecular axis of a liquid crystal molecule, that is, ferroelectric liquid crystal, is used as this liquid crystal 6. Ferroelectric liquid crystal being developed now shows a chiral smectic C phase in smectic liquid crystal. In order to orient the liquid crystal molecule parallel to the glass substrates, the space between the substrates is maintained approximately for 1 μm, for example, in the case of

using *P*-decyloxybenzyliben *P'*-amino 2 methyl butyl cinnamate. In addition, the liquid crystal molecule is oriented parallel to a length direction of the second transparent electrode (vertical to the paper). This is realized by performing rubbing treatment or the like to the glass substrates.

In such a liquid crystal cell, first, voltage is applied between the two electrodes in the second transparent electrode 4 to generate an electric field transverse to the glass substrates. Subsequently, an electric field is applied from the first transparent electrode 2 of the glass substrate (B)11 to the first transparent electrode 2 of the glass substrate (A)1 side by applying voltage between the both electrodes (this is referred to as a longitudinal electric field; note that, a transverse electric field is not applied while a longitudinal electric field is applied).

In the above described embodiment, the permanent dipole of the liquid crystal molecule generates torque of 90° direction due to the transverse electric field generated by applying voltage between the two electrodes in the second transparent electrode; thus, the direction of the permanent dipole is changed to the direction of the electric field. In other words, the molecule orientation direction is also changed. Then, the permanent dipole of the liquid crystal molecule responds again by the next generated electric field from the glass substrate (B)11 to the glass substrate (A)1 direction; therefore, the molecule orientation direction is also changed.

Torque of a liquid crystal molecule is increased by making the liquid crystal molecule respond as described above more than by using a conventional method of applying an electric field between the glass substrates 12; thus, the liquid crystal molecule can response more rapidly.

Further, as shown in FIG. 3, a plurality of second transparent electrodes 4 is provided, each space between the second transparent electrodes is connected with a resistor, and voltage is applied between the second transparent electrodes placed at the both edges in order to obtain a transverse electric field with low voltage and in a wide range. Therefore, the liquid crystal driving device can be applied to a display element or the like because the transverse electric field can be obtained in a wide range.

[Effect of the Invention]

As described above, in the present invention, increased rotational torque can be realized in a liquid crystal molecule by a structure having a second transparent electrode. Therefore, response speed of the liquid crystal molecule becomes rapider than that with a conventional method.

4. Brief Description of Drawings

FIG. 1 and FIG. 3 each are a cross-sectional view of a liquid crystal driving device showing one embodiment of the present invention.

FIG. 2 is a cross-sectional view of a conventional liquid crystal driving device.

1. glass substrate (A)

2. first transparent electrode

3. first insulating film

4. second transparent electrode

5. second insulating film

6. liquid crystal

7. permanent dipole moment of a liquid crystal molecule

8. transparent electrode

9. insulating film

10. spacer

11. glass substrate (B)

12. glass substrate

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